PALMAR DERMATOGLYPHICS
IN
DIABETES MELLITUS

THESIS

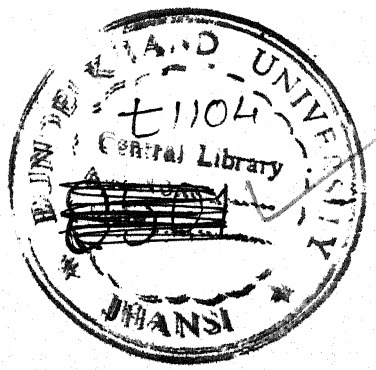
FOR DOCTOR OF MEDICINE

[MEDICINE]

BUNDELKHAND UNIVERSITY,

JHANSI.

1983



SATISH KUMAR

C E R T I F I C A T E

This is to certify that the work entitled "PALMAR DERMATOGLYPHICS IN DIABETES MELLITUS" which is being submitted as thesis for M.D.(Medicine) examination of Bundelkhand University, Jhansi, 1983, by Dr. Satish Kumar has been carried out under my guidance and supervision. The techniques described were undertaken by the candidate himself and the observations recorded have been periodically checked by me.

He has put in necessary stay in the department as per university regulations.

(R. C. ARORA)
M.D.
Head of the Department of Medicine
M.L.B. Medical College
JHANSI

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(R.C. ARORA)
M.D.,
READER,
DEPARTMENT OF MEDICINE,
M.L.B. MEDICAL COLLEGE,
JHANSI

GUIDE

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Jain

(P.K. JAIN)
M.D.,MNAMS.,
LECTURER,
DEPARTMENT OF MEDICINE,
M.L.B. Medical College,
JHANSI

CO-GUIDE

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(SATISH KUMAR)

C O N T E N T S

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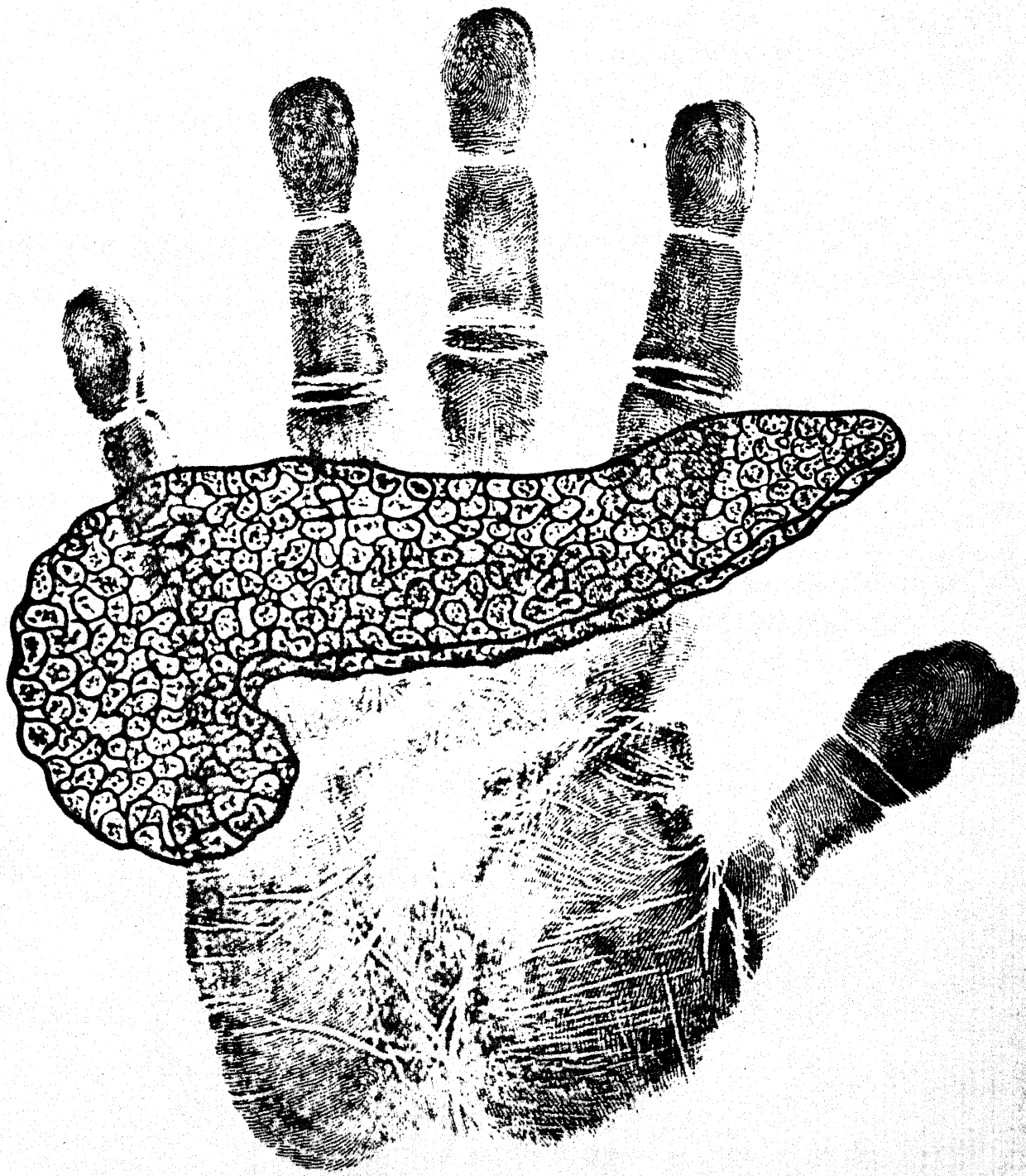
INTRODUCTION

DERMATOGLYPHICS IN DIABETES MELLITUS AND FIRST BLOOD RELATIVES



SATISH KUMAR
R. C. ARORA
P. K. JAIN

DEPARTMENT OF MEDICINE,
M.L.B. MEDICAL COLLEGE, JHANSI.

REVIEW OF LITERATURE

History

Lines on the human hand have, since long, been a subject of great interest. Significance of these lines in predicting the course of future event has been emphasized by fortune tellers. Their utility in identifying criminals is also well recognized. However, their biomedical significance is not so well known.

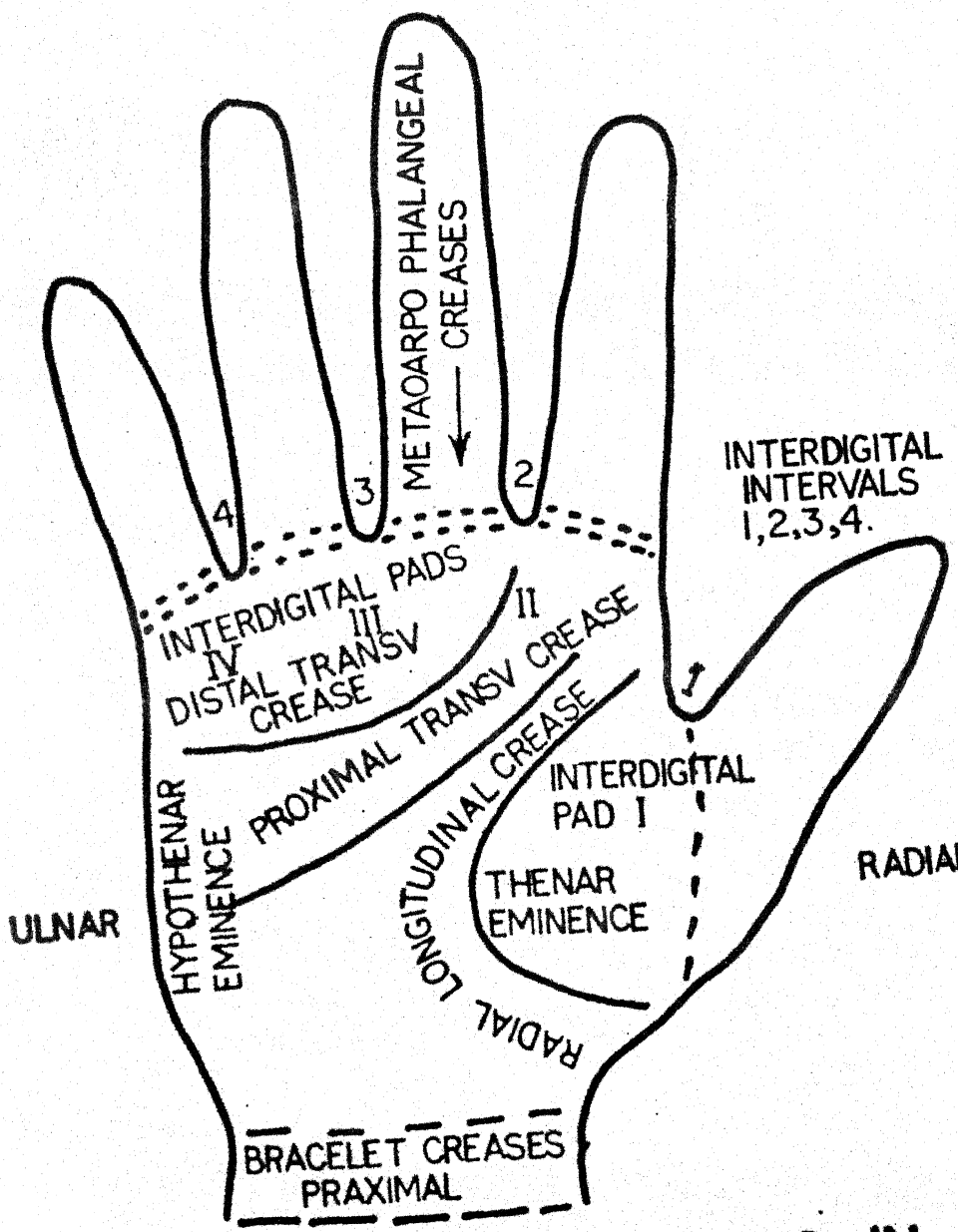
The system of identification by finger prints, had its origins in China where it was in vogue for many centuries. The Chinese employed the finger print systems for the signing of contracts by illiterate persons. In foundling asylums every infant on its reception was recorded for possible identification, the design of his finger tips being the most important part of the record.

The history of Chinese seals begins with the famous seal of Emperor Te' in Shi, B.C. 246-210. It was carried from white jade, but prior to this seals were made of clay, on one side of which was the name of the owner and on the other the impression of his thumb, the later evidently serving the purpose of identification.

The Chinese, though well acquainted with the various patterns found in finger prints did not, however, develop them into a system of classification.

Early Scientific Study

Scientific interest in this field is also old. It dates back to 17th century when scientific workers like Nehemiah Grew, fellow of the College of Physicians and Surgeons of the Royal Society, England in 1681 and Marcello Malpighii, Professor of Anatomy at the University of Bologana, Italy in 1686 described the morphology of various parts of the palm. Other pioneers in this field have been Johannes Evangelist. Purkinje who in 1823 submitted a thesis at University of Berslau for the degree of 'Doctor of Medicine', describing finger prints' type and classifying them in nine major groups. Henry Faulds, an Englishman, working at the Tsukiju Hospital, Tokyo, around 1858 collected the finger prints of Japanese and other nationalities and compared their ethnological differences. He also gave the valuable suggestions of identifying a criminal by his finger prints left at the scene of crime. Sir Francis Galton, England in 1892 took up the study of papillary ridges with great interest and proved through experiments that there is



ANATOMICAL LANDMARKS IN PALMAR DERMATOGLYPHICS

(HAROLD CUMMINS & CHARLES MIDLO)

1943

(3) By far the most advantageous field of biological and medical investigation is that concerned with the topography of the systems of parallel ridges at microscopic level, that is, as seen fairly easily by the naked eye or with a magnifying hand lens. In general now flexion creases are also studied under the field of dermatoglyphics the term having been coined by Cummins and Midlo in 1926.

Cummins' interest in dermatoglyphics was first aroused by the toe configurations of an anatomical subject, the study appeared in 1923.

Kristine Bonnevie (1924) worked on various aspects of inheritance and on embryological processes leading to the expression of particular configuration. She was the first to use "Quantitative Value", based on the ridge count, instead of traditional qualitative values of finger print types to determine the inheritance of finger prints.

In 1926 Cummins published three other papers one dealing with a new way to time intrauterine digital eruptions and another with the ridge configurations of developmental defects.

Dermatoglyphics in Population Studies

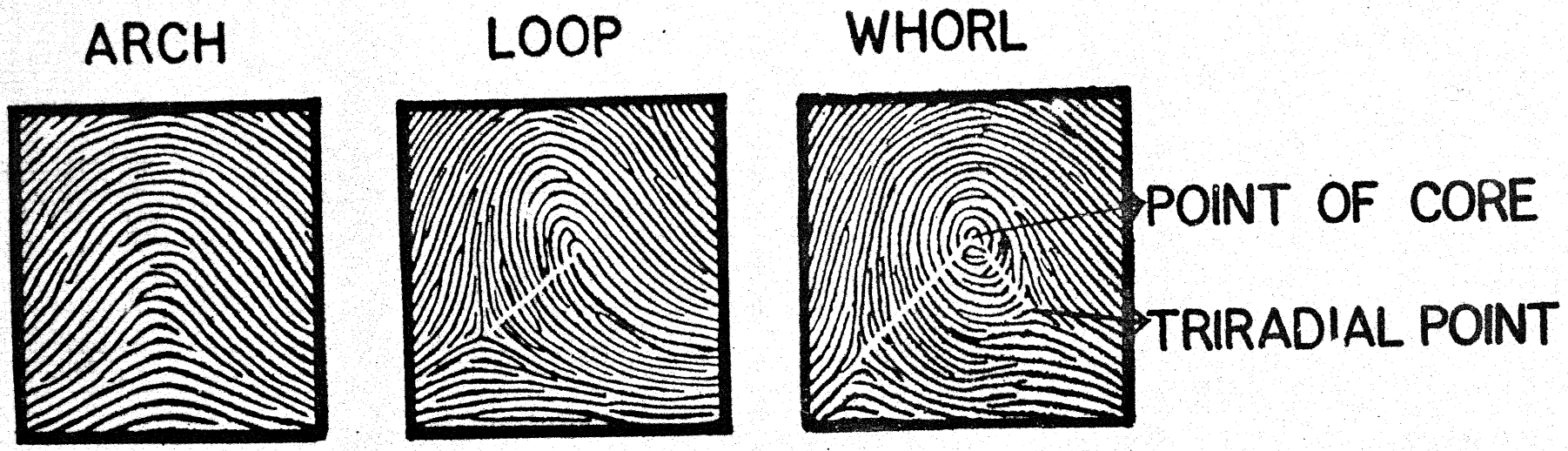
Cummins and Midlo (1926) were first to publish dermatoglyphics of European and American population. Cummins in 1927 published dermatoglyphics in Jews and Negroes of West America. This was the start of long study of dermatoglyphics in different social groups which was carried out by Cummins and Midlo and many others throughout the world. In India, considerable work has been done on racial variations of dermatoglyphics and much more is still in progress (Mukherjee, 1970; Kumar Santosh 1974).

Dermatoglyphics and Genetics

Genetic studies of the finger pattern types, arches, loops, whorls were confusing; but study of a quantitative value - the total finger ridge count of the ten fingers - provided an excellent example of polygenic inheritance. Resemblance between relatives was found to be surprisingly close to the number of genes that on average such relatives have in common. For example, a correlation of 0.5 (expected 0.5) was found for parent and child or brother and sister and dizygotic twins, 0.95 (expected 1.0) for monozygotic co-twins, close to zero for husband and wife. The similarity of the total finger ridge count of

monozygotic co-twins (proved to be monozygotic by full blood typing) has made finger prints a useful adjunct to determining the type of twining. There are indications that not many gene loci are involved in determining the ridge-count, but no success has linkage and chromosomal studies.

At present there is wide agreement that the heredity of most dermatoglyphic features confirms to a polygenic system, with individual genes contributing a small additive effect. Modern cytogenetic methods, which allows rather precise identification of chromosomes, are certainly to be of great value in studying the correlations between individual chromosome aberrations and dermatoglyphic features and may lead to establishing the loci of genes that influence dermatoglyphics. However a limitation to the precise genetic analysis of dermatoglyphics is the difficulty in delineating some features and reducing them to quantifiable characteristics. Many transitional features exist and too much latitude for subjective classification is still possible. Improvements in reliability of classification and more precise delineation of dermatoglyphic features will undoubtedly be followed by advances in understanding of the importance of genetic factors in the development of epidermal ridge configurations.



SHOWING DIGIT PATTERNS AND RIDGE COUNT FROM TRIRADIAL TO POINT OF CORE

Dermatoglyphic analysis has several advantages :-

1- It can be applied readily.

2- Results are available immediately as a clinical diagnostic tool.

3- Expensive and elaborate pieces of equipment are not required.

4- The procedure is atraumatic.

DERMATOGLYPHIC NOMENCLATURE

I- Finger Print Topography

Three basic patterns are distinguished(Galton):-

(a) Loop (L) : The ridges enter and end on the same side forming a hair pin like pattern. It has a centre or core and a triangle which is called a triradius. If they open towards the ulnar side, they are called as ulnar loops and if they open towards the thumb they are called as radial loop.

(b) Whorls (W) : The whorl is a design where the majority of ridges made a circle around the core or hub. It has two triradii.

(c) Arches (A) : The ridges run in arches, parallel to each other. It has no triradius.

Distribution of Pattern Types on Single Digits :

On every digit ulnar loops are the most abundant pattern, the frequency ranging downward from

88% in digit V, 74% in III, 62% and 61% respectively in IV and I, and 35% in digit II.

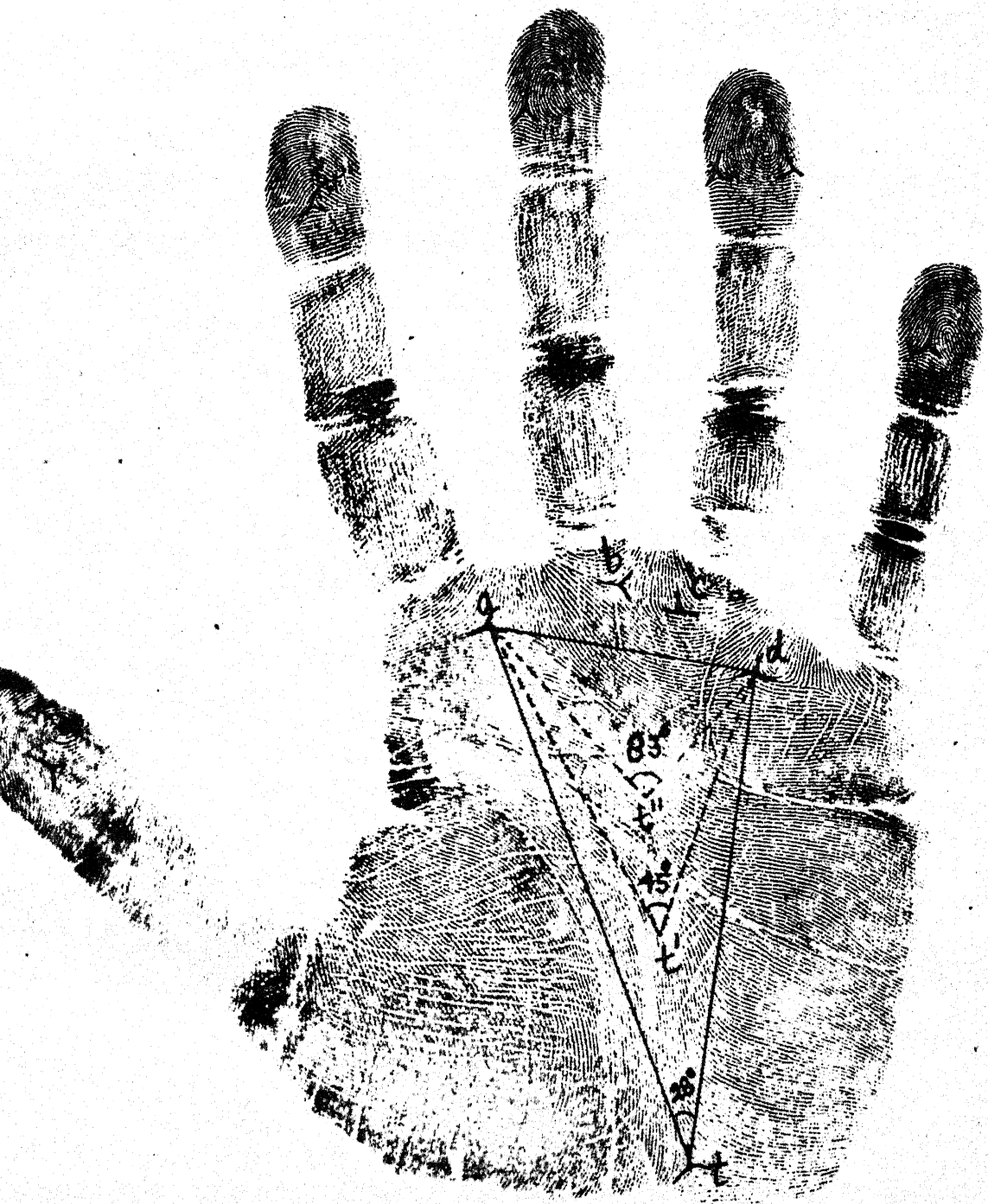
Whorls, next in total frequency, are most numerous on I and IV, 35% and 34% respectively, while II is not much lower, 30%; III and V present a sharp reduction, 16% and 11% respectively. Of all pattern types, radial loops have the greatest relative range of frequency among the digits. They occur in 25% of index finger, 30% in III, 1% in IV and in I and V they are reduced to very small fractional percentages 0%, 0.2% and 0.1%. The frequency of arches is 11%, 7%, 4%, 2% and 1% on II, III, I, IV and V respectively (Cummins and Midlo).

II- Ridge Count from Triradial Point to Point of Core

Ridge count is the number of ridges between the triradius and the core of the pattern. Total ridge count which is the total score of all ten fingers, has been found to be genetically controlled. The ridge count is zero for an arch and twice as much as for a whorl as for a loop of comparable size (Bonnevie).

III- Triradii

The triradii in the palm are more significant than those which are associated with finger print patterns. The meeting point of three different fields



SHOWING DIFFERENT TRIRADII
AND atd ANGLE

of parallel ridges of the patterns is known as triradius which is the main land mark for classification of prints (Cummins and Midlo; Hale et al and Penrose). The triradii are of two types :-

1) Digital triradii : These are known as a, b, c and d in radioulnar sequence located on the base of the 2nd, 3rd, 4th and 5th fingers.

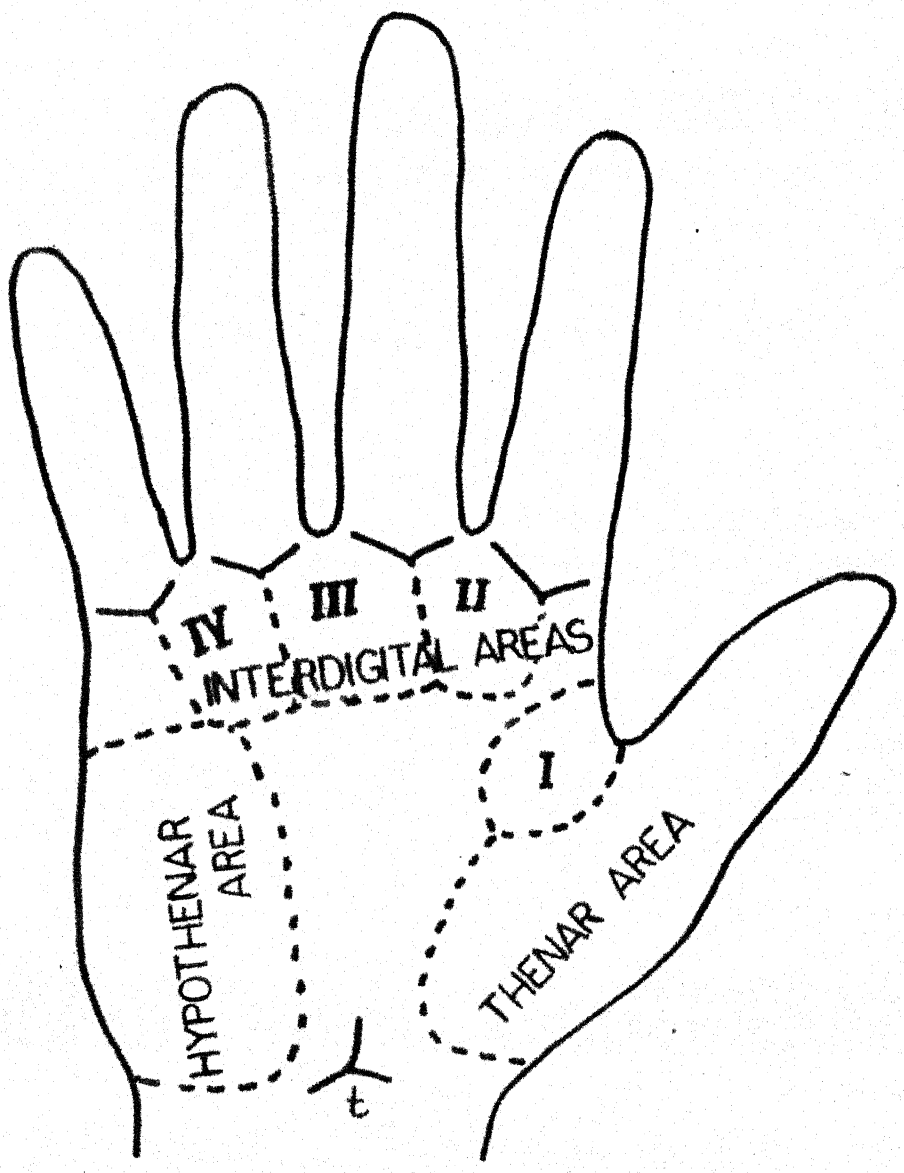
2) Axial triradius : It is indicated as t (near the wrist crease) t" (near the centre of the palm) and t' (intermediate lying near a line transecting the base of the thumb). A composite of X-ray of digits and axial triradii shows that the distribution of axial triradii is confined rather closely to the axis of the 4th metacarpal bone.

IV- atd angle

The atd angle is formed between lines drawn from the triradii at the base of the index and little fingers to the axial triradius. The more distal the axial triradius the larger is the angle. The position of the axial triradius forming an angle greater than 56 degrees is designated as distal or t", between 44 to 56 degree as t' and below 43 degrees as t.

V- Palm

The main areas of palm are the thenar, hypothenar emineces and interdigital areas between different fingers.



MAP OF THE SIX CHIEF DERMATOGLYPHIC AREAS OF THE PALM (CUMMINS & MIDLO 1943)

There are three flexion creases found on the palm, the palmist's 'line of life', 'line of heart' and the 'line of head'. Sometimes two of these, i.e. line of heart and line of head are fused together. In that case, it is called a 'simian line'.

VI- Sole

It is divided into 8 configurational zones viz I, and II hallucal areas combined with the first interdigital areas; III, IV and V interdigital areas, VI hypothenar area, distal and proximal; VII thenar area, distal and proximal, and VIII calcar area (Wilder)

Sexual Variation in Dermatoglyphics (Cummins and Midlo)

There are some differences in the dermatoglyphical findings of males and females which are as follows :-

(1) Ridge breadth : In female the ridges are narrower. In young adult males, the mean number of ridges per centimeter is 20.7, a value to be compared with 23.4 in young adult females. Ridges in the females are significantly finer, since on the average there are 2.7 ± 0.09 more ridges per centimeter as compared to males. This sexual difference, of-course expresses itself only in the general trend.

(2) Size of hand : Females usually have the smaller size of the hand as compared to males.

(3) Finger print types : Among various racial sample females almost universally differ from males in having more arches and usually they differ also in having fewer whorls. The arch/whorl index is almost without exception higher in females. Radial loops are fewer in females.

DERMATOGLYPHIC FINDINGS IN NORMAL SUBJECTS

The following tables give the incidence of patterns of fingers, toes and hallucal area of the sole in normal subject (Penrose) :-

TABLE I - FINGERS

Patterns	Thumb %	Index %	Middle %	Ring %	Little %
Ulnar loops	60.89	35.20	74.07	87.62	62.27
Radial loops	0.21	24.70	2.52	0.11	0.98
Whorls	35.41	29.47	16.37	11.44	34.44
Arches	3.49	10.63	7.04	0.83	2.31

TABLE II - TOES

Patterns	I %	II %	III %	IV %	V %
Arches	11.8	8.7	4.8	20.9	51.5
Loops	80.4	72.4	37.5	60.6	48.9
Whorls	7.8	18.9	57.7	18.7	0.6

TABLE III

INCIDENCE OF PATTERNS ON THE HALLUCAL AREA OF THE SOLE

Patterns	Frequency
Whorls	30.8%
Loop distal	48.5%
Loop tibial	7.3%
Open field	12.2%
Others	1.2%

RIDGE COUNT :

Score of all ten fingers.

Males	:	145
Females	:	127
Normally arch	:	Nil
Loop	:	About 12
Whorl	:	About 19

POSITION OF AXIAL TRIRADIUS :

In most of the persons (64%) it is present towards the wrist but in majority of mongolism patients it is placed distally i.e. towards the finger's base side.

at d ANGLE :

Normally it is about 45% but it may increase in many diseases.

SIMIAN LINE :

It is present in only 2% of normal individuals.

DERMATOGLYPHICS IN NORMAL INDIAN POPULATION :

Broad statistical results of dermatoglyphic analysis of finger, palm, toe and sole prints have been presented by Mukherjee and Saha in normal Bengalee population as follows :

Whorls	:	40%
Ulnar loop	:	55%
Radial loops	:	2%
Arches	:	3%

TOTAL RIDGE COUNT :

Score of all ten fingers :

Males : 153.50

Females : 140.12

These results suggested greater homogenicity of the Bengalee caste populations compared to other parts of India.

In North Indian population the dermatoglyphical findings in healthy children were studied by Kumar, Mangal and Kumar.

DERMATOGLYPHICS AS A DIAGNOSTIC AID :

For many years, dermatoglyphics has been accepted as a useful tool in the differentiation between monozygotic and dizygotic twins. Biologically, dermatoglyphics has great value in determining the zygosity type and thus, for renal transplants to be successful the donor and recipient should be identical twins. Thus a biologically appropriate choice may be made form studying the dermal ridges.

Interest regarding the significance of dermatoglyphics in the field of medicine is relatively new. Its significance in Mongolism was first demonstrated by Cummins (1926). In his paper he wrote "In these series of Mongoloids idiots, the dermatoglyphics of finger type and palms present a number of

characteristic markedly differing from those of a racially comparable normal child". It is a pity that this diagnostic aid was not further explored, as with the development of chromosomal staining technique in 1960, it was proved that Mongolism was associated with chromosomal aberration.

Since then, with the rapid development of human cytogenetics, the discovery of chromosomal aberrations and knowledge of genetic diseases and syndromes, the value of dermatoglyphics in clinical medicine has been proved. These are Turner's syndrome, Klinefelter's syndrome, D & E Trisomy, De Lange syndrome, Congenital heart diseases, Schizopharenia, Anencephaly, Phenylketonuria and Neurofibromatosis.

There are other clinical entities in which dermatoglyphical studies are underway in various parts of the world are; Systemic Lupus Erythematosus, Pseudohypoparathyroidism, Thalassaemia syndrome, Diabetes, Leprosy, Coeliac diseases, Leukemia, Schizophrenia, Childhood cirrhosis, Wilson's disease, Sickle cell disease, Cardiovascular diseases, Rubella syndrome, and Retinoblastoma, etc., to name only few.

Some social problems like juvenile delinquency, criminal behaviour and mental retardation are also being investigated for dermatoglyphic markers.

TABLE IV - CHARACTERISTIC DERMATOGLYPHICS IN CHROMOSOMAL ABERRATION SYNDROMES *

	Fingers	Palms	Hallucal Area of sole
Down's syndrome (trisomy 21 or translocation type)	Ten ulnar loops (60%) Radial loop on 4th and/or 5th digits.	Distal axial triradius (85%) Single flexion crease (50%)	Arch tibial (50%) Small loop distal (35%)
D1 trisomy	Increased number of arches Low TFRC †	Very distal axial triradius Single flexion crease Thenar pattern	Large Pattern, loop tibial or arch fibular
18 Trisomy	6-10 arches(also on toes) Single flexion crease on 5th digit. Very low TFRC	Distal axial triradius Single flexion crease	
Cri du chat syndrome (deletion short arm of No.5)	Increased number of arches Low TFRC	Distal axial triradius "Bridged" flexion crease	Open field
Turner's syndrome.	Variable; patterns usually large loops or whorls High TFRC	Axial triradius slightly more distal than average	Very large patterns, usually loop or whorl.
Klinefelter's syndrome	Increased No. of arches TFRC below average	Axial triradius more proximal than average	
Deletion long arm of No.18	Excess whorls	Simian line	Open field.
Other syndromes with extra X and Y chromosomes.	Increased number of arches Reduced TFRC; the more X's and Y's present the reduction is greater.	-	-

* Based chiefly upon the data of Walker (1957), Penrose (1968), Uchida and Soltan (1963) and Holt(1968)
† TFRC = Total Finger Ridge Count.

DERMATOGLYPHICS IN DIABETES MELLITUS :

The first investigation of dermatoglyphics in diabetes mellitus was done in 1973 by Verbov, London. He studied dermatoglyphics in early onset (/ 40 years) diabetes mellitus and found -

(1) Decrease incidence of whorls, and increase incidence of arches in early onset female diabetics,

(2) Pattern frequencies in left third area in female diabetics and in the fourth area in male diabetics was significantly different,

(3) a-b ridge count in female diabetics was low.

Vormittag et al (1974) studied both early and late onset diabetes mellitus and observed :-

(1) Increase in whorls in both early and late onset male diabetics.

(2) Decrease in loops in early onset male diabetics.

(3) Increase in arches in both early and late onset male diabetics.

(4) In thenar area decrease in pattern frequency of right hand in early onset female diabetics and decrease in late onset diabetes mellitus.

(5) In hypothenar area patterns (mainly loops) were more frequent in both male and females.

Bhu et al(1980) from India also studied dermatoglyphics in both early and late onset diabetes mellitus and found -

(1) Increase in whorls in early onset male diabetics.

(2) Increase in loops in late onset male diabetics while decrease in early onset male diabetics.

(3) Increase in arches in early and late onset female and male diabetics.

(4) Decrease patterns in III interdigital area in early onset male diabetics.

(5) Markedly low incidence in pattern frequency in both sexes and both type.

Gracia-Sagredo et al (1977) also studied dermatoglyphics of 152 diabetic patients (males and females) and grouped the patients according to infantile onset and adult onset. He also observed significant differences.

Paintal I.S. (1978) also observed different dermatoglyphic features in diabetes mellitus.

The role of dermatoglyphics as a diagnostic tool is worth notice. It certainly helps in fortifying a clinical diagnostic impression even if it does not surely lead to confirmation of the diagnosis. As Achs had emphasized, that dermatoglyphic findings

"prompt the physician to make a more thorough examination than usual to find out any hidden abnormality".

If a marker in diabetes mellitus cases could be found, the possible predisposition to such illness can be known right from the birth. What is needed is more research in this branch of science.

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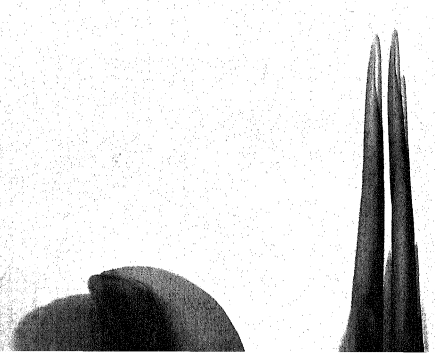


MATERIAL & METHODS

This study was carried out in 100 consecutive cases of diabetes mellitus attending diabetic clinic and/or patients admitted in M.L.B. Medical College Hospital, Jhansi and their 60 available first blood relatives. Diagnosis of diabetes mellitus was made according to clinical and biochemical criteria of W H O Expert Committee on Diabetes Mellitus, 1980.

Only those cases included in the study who developed diabetes mellitus spontaneously. The diabetes mellitus cases were divided into juvenile or early onset ($\leq$ 40 years) and maturity or late onset ($\geq$ 40 years) according to their age of onset of disease (Verbov, 1973; Foster, 1980). There were 50 cases of early onset diabetes mellitus (30 males and 20 females) and 50 cases of late onset diabetes mellitus (30 males and 20 females). Among first-blood relatives 40 were males and 20 females.

120 age and sex matched healthy subjects who did not have any personal or family history of diabetes mellitus and had normal blood sugar were studied as controls.

All subjects were of Indian ancestory having their grand parents born in India. Patients who had any associated conditions which are known to have abnormal dermatoglyphic characteristics were excluded.

DIFFERENT DERMATOGLYPHICAL PARAMETERS STUDIED

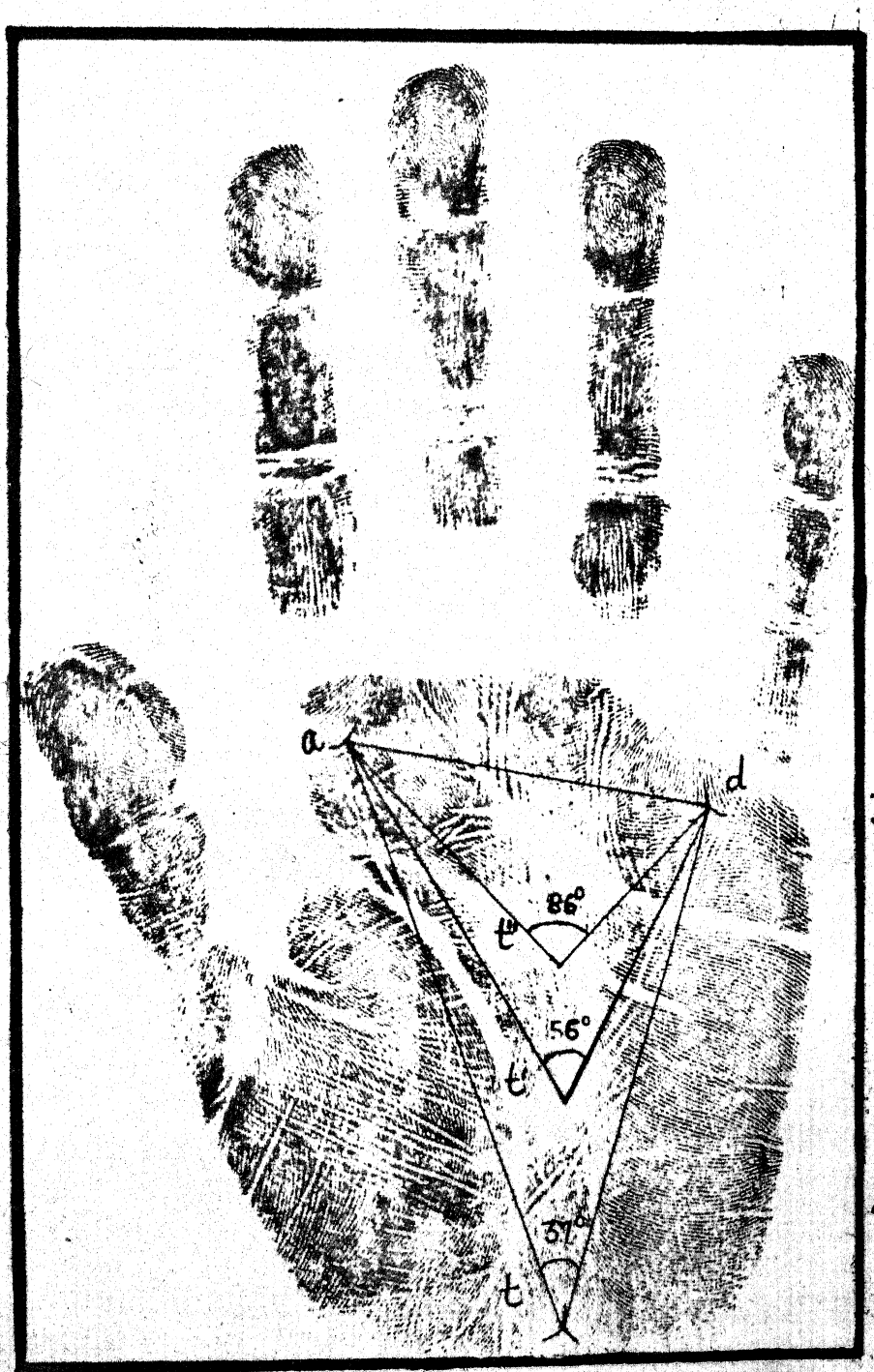
WHORL

LOOP

ARCH

1. DIGIT PATTERN

2. RIDGE COUNT (TFRC)



3. AXIAL TRIRADII

4. atd ANGLE

The Cotterman technique of taking the prints of palms and fingers comprised of first cleaning and then drying the skin of the palms and fingers of both hands. Then a small daub of printer's ink was placed on a sheet of paper and spread with a roller into a thin even film. The roller was then rolled on the outstretched palm. After ensuring that the ink had spread evenly, the palm was applied on a sheet of plain art paper and uniform pressure exerted on the dorsal aspect of the hand. The palm was then removed and the print was left to dry.

These prints were analysed with the help of a magnifying lens.

All the relatives were subjected to clinical and biochemical evaluation to find out evidence of diabetes mellitus in them and it was correlated with dermatoglyphic patterns.

The analysis of the finger and palm prints of both hands was done under the following four headings :

1- Digit patterns of the finger :

(a) Whorl (W)

(b) Loop (L)

(c) Arch (A)

2- Ridge count : This was done from triradial point to point of core. A single value for an individual

was obtained as total finger ridge count (TFRC) consisting of a quantitative assessment of pattern on the fingers (Bonnevie, 1924).

3- Presence of Axial triradius and its position.

4- Value of a t d angle.

Blood sugar estimation was done by Folin-Wu method (1920).

Statistical analysis was done by test of significance with Students "t" test for quantitative evaluation and Chi-square (χ^2) test for qualitative evaluation.

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OBSERVATIONS

The present study was carried out in 100 consecutive cases of diabetes mellitus, 60 first blood relatives of diabetes mellitus patients and 120 age and sex matched normal healthy subjects. The individuals studied were 280 which comprised of 560 palms and 2,800 fingers. The different groups of subjects are shown in table V.

TABLE V

Showing number of subjects in different groups.

Group	Male	Female	Total
Diabetes Mellitus			
Early onset	30	20	50
Late onset	30	20	50
First Blood Relatives	40	20	60
Normal Healthy Controls	80	40	120
Total	...	...	280

Table VI shows the percentage frequency of digit patterns in early onset male diabetics which indicates the predominence of whorls in the digit III and V of both right and left hand i.e. 56.67%, 50.00%, 63.33% and 63.33% as compared to 17.5%, 20%, 27.5% and 25% of controls respectively. Conversely occurence of loops was low 33.33% in digit III of both right and left sides compared to 75% and 70% of controls. Arches were of increased percentage of left and right digit II 26.67% and 20% respectively.

Observation of table VII shows significant difference in digit patterns in early onset male diabetics from controls ($P < 0.001$). The incidence of whorls was more 49% as compared to controls 37.5% while loops were less 40% as compared to controls 56.25%. Arches were of higher frequency 11% as compared to 6.25% in controls.

Percentage frequency of digit patterns in early onset male diabetics(30 cases) and controls(40 cases).

DIGITS	RIGHT						LEFT					
	Whorl		Loop		Arch		Whorl		Loop		Arch	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
DIGIT I												
Diabetes Mellitus	12	40	15	50	3	10	18	60	10	33.33	2	6.67
Controls	17	42.5	21	52.5	2	5	14	35	24	60	2	5
DIGIT II												
Diabetes Mellitus	11	36.67	13	43.33	6	20	08	26.67	14	46.66	8	26.67
Controls	20	50	16	40	4	10	14	35	20	50	6	15
DIGIT III												
Diabetes Mellitus	17	56.67	10	33.33	3	10	15	50	10	33.33	5	16.67
Controls	07	17.5	30	75	3	7.5	08	20	28	70	4	10
DIGIT IV												
Diabetes Mellitus	15	50	15	50	0	0	14	46.67	12	40	4	13.33
Controls	23	57.5	17	42.5	0	0	26	65	13	32.5	1	2.5
DIGIT V												
Diabetes Mellitus	19	63.33	11	36.67	0	0	19	63.33	10	33.33	1	3.33
Controls	11	27.5	29	72.5	0	0	10	25	27	67.5	3	7.5

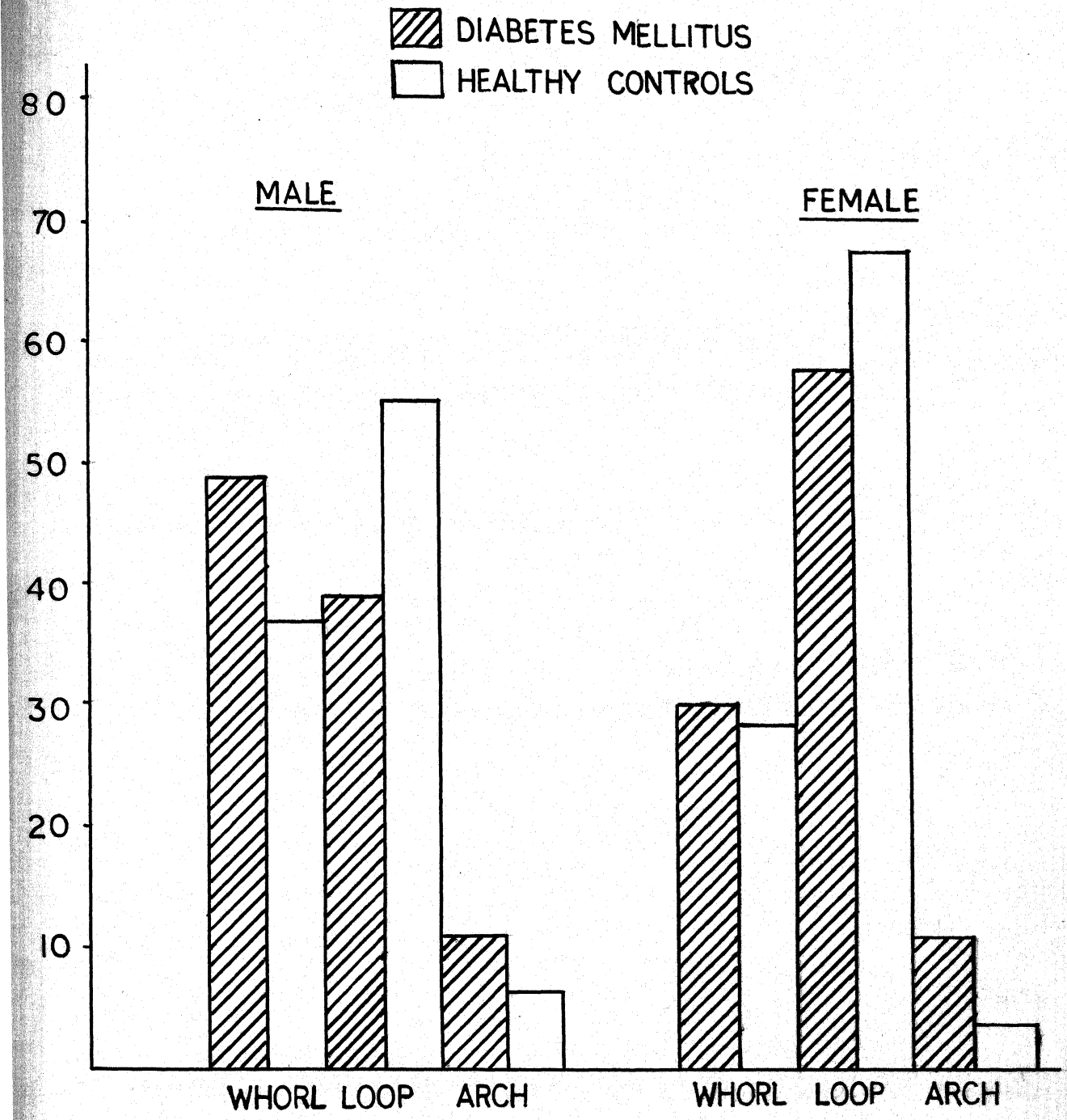
TABLE VII

Statistical analysis of digit patterns in early onset male diabetics (30 cases) and controls(40 cases)

Pattern	RIGHT					LEFT					Total	%	X^{2*}	P
	I	II	III	IV	V	I	II	III	IV	V				
Diabetes Mellitus														
Whorl	12	11	17	15	19	18	08	15	14	19	148	49	18.93**	$\leq$ 0.001
Loop	15	13	10	15	11	10	14	10	12	10	120	40		
Arch	03	06	03	00	00	02	08	05	04	01	32	11		
Controls														
Whorl	17	20	07	23	11	14	14	08	26	10	150	37.5	-	-
Loop	21	16	30	17	29	24	20	28	13	27	225	56.25		
Arch	02	04	03	00	00	02	06	04	01	03	25	6.25		

* Degrees of freedom (d.f.) is 2

** Highly significant value as compared to control (P $\leq$ 0.001)



SHOWING PERCENTAGE FREQUENCY OF DIGIT PATTERNS IN EARLY ONSET DIABETES MELLITUS

Table VIII depicts the percentage frequency of digit patterns in early onset female diabetics. This revealed decreased percentage frequency of whorls in right and left digit IV 35% and 30% as compared to controls 65% and 60% respectively. There was also decreased percentage frequency of loops in digit III of right and left hands i.e. 45% as compared to controls 90% and 80% respectively. Decreased incidence was also in left digit II 45% as compared to controls 85%. The percentage frequency of arches was 25% and 15% in left digit II, IV and in right digit I and III 10% each as compared to complete absence of arches in above digits in controls.

Statistical analysis of digit patterns (table IX) in female early onset diabetics from controls shows significant difference ($P < 0.05$). The incidence of loops was low 59% as compared to controls 67.5% while increased incidence of arches 10% as compared to 3.5% in controls. There was no differences in whorls as compared to controls.

TABLE VIII

Percentage frequency of digit patterns in early onset female diabetics(20 cases)and controls(20 cases

DIGITS	RIGHT						LEFT					
	Whorl		Loop		Arch		Whorl		Loop		Arch	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
DIGIT I												
Diabetics	06	30	12	60	02	10	05	25	15	75	00	00
Controls	06	30	14	70	00	00	02	10	16	80	02	10
DIGIT II												
Diabetics	08	40	10	50	02	10	06	30	09	45	05	25
Controls	07	35	12	60	01	05	03	15	17	85	00	00
DIGIT III												
Diabetics	09	45	09	45	02	10	08	40	09	45	03	15
Controls	02	10	18	90	00	00	03	15	16	80	01	05
DIGIT IV												
Diabetics	07	35	13	65	00	00	06	30	11	55	03	15
Controls	13	65	06	30	01	05	12	60	08	40	00	00
DIGIT V												
Diabetics	04	20	16	80	00	00	03	15	14	70	03	15
Controls	05	25	14	70	01	05	05	25	14	70	01	05

TABLE IX

Statistical analysis of digit patterns in early onset female diabetics (20 cases) and controls (20 cases).

Pattern	RIGHT					LEFT					Total	%	X^{2*}	P
	I	II	III	IV	V	I	II	III	IV	V				
Diabetes Mellitus														
Whorl	06	08	09	07	04	05	06	08	06	03	62	31		
Loop	12	10	09	13	16	15	09	09	11	14	118	59	7.55**	/ 0.05
Arch	02	02	02	00	00	00	05	03	03	03	20	10		
Controls														
Whorl	06	07	02	13	05	02	13	03	12	05	58	29		
Loop	14	12	18	06	14	16	17	16	08	14	135	67.5	-	-
Arch	00	01	00	01	01	02	00	01	00	01	07	3.5		

* Degrees of freedom (d.f.) is 2

** Significant value as compared to control (P / 0.05)

Table X shows predominence of loops in digit IV of both hands in late onset male diabetics i.e. 73.33% in left and 60% in right as compared to controls 32.5% and 40% respectively. Conversely in the same digit whorls were of decreased frequency i.e. 26.67% and 30% as compared to 65% and 60% of controls. The occurence of arches showed increased frequency i.e. 16.67%, 26.67% in right digit II and III respectively and 20% each in left digit II and III.

Table XI shows statistically different digit patterns in cases of late onset male diabetics as compared to controls ($P < 0.001$). There was highly significant low occurence of whorls 21% compared to controls 40.5% while high occurence of loops 68.77% and arches 10.33% as compared to controls 54.75% and 4.75% respectively.

TABLE X

Percentage frequency of digit patterns in late onset male diabetics (30 cases) and controls(40 cases

DIGITS	RIGHT						LEFT					
	Whorl		Loop		Arch		Whorl		Loop		Arch	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
DIGIT I												
Diabetics	8	26.67	22	73.33	00	00	8	26.67	22	73.33	00	00
Controls	18	45	20	50	2	5	16	40	20	50	4	10
DIGIT II												
Diabetics	9	30	16	53.33	5	16.67	7	23.33	17	56.67	6	20
Controls	21	52.5	15	37.5	4	10	15	37.5	22	55	3	7.5
DIGIT III												
Diabetics	5	16.67	17	56.67	8	26.67	2	6.67	22	73.33	6	20
Controls	8	20	28	70	4	10	10	25	29	72.5	1	2.5
DIGIT IV												
Diabetics	9	30	18	60	3	10	8	26.67	22	73.33	0	00
Controls	24	60	16	40	0	00	26	65	13	32.5	1	2.5
DIGIT V												
Diabetics	5	16	22	73.33	3	10	2	6.67	28	93.33	00	00
Controls	12	30	28	70	0	00	12	30	28	70	00	00

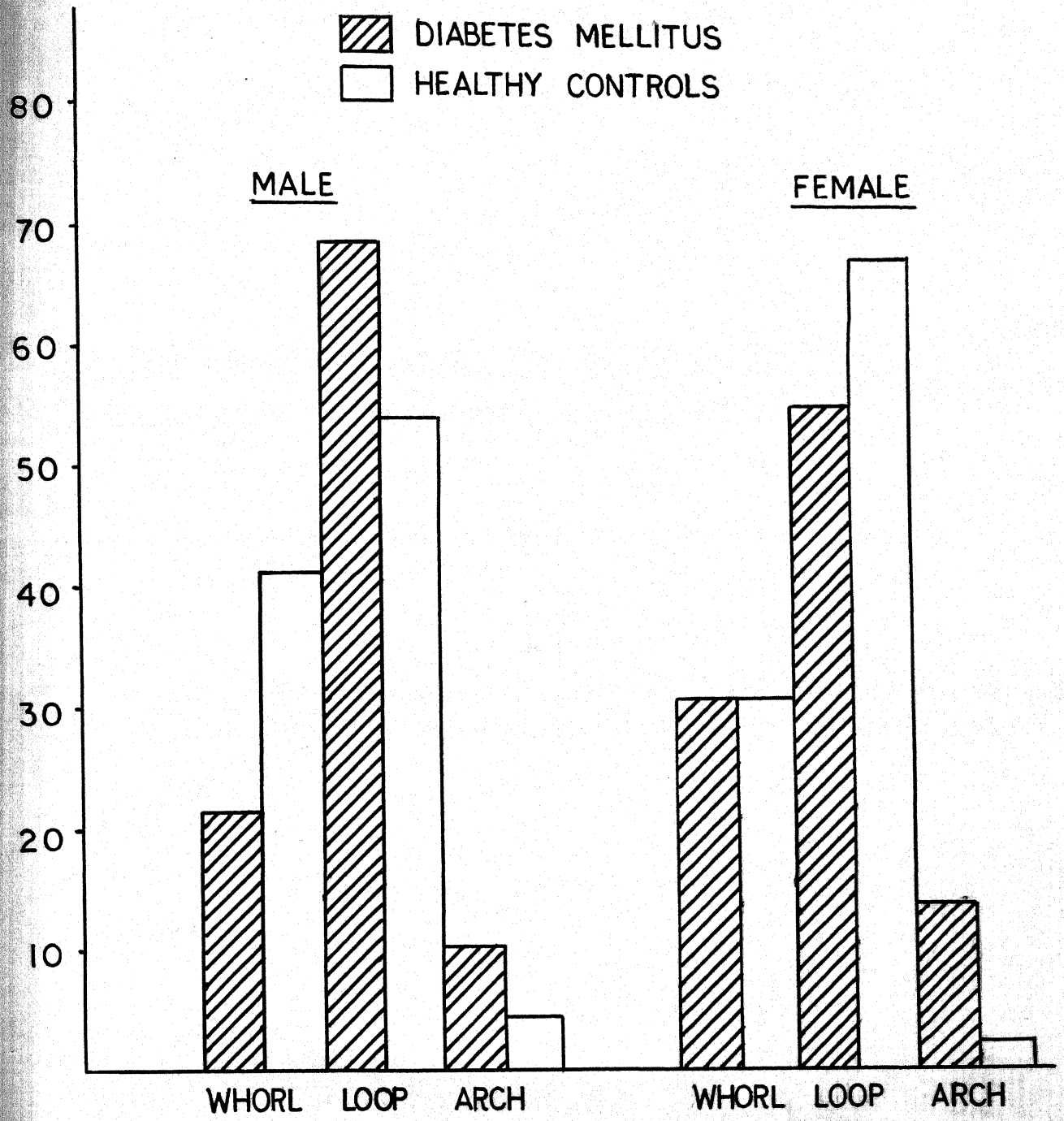
TABLE XI

Statistical analysis of digit patterns in late onset male diabetics (30 cases) and controls(40 cases).

Pattern	RIGHT					LEFT					Total	%	X^{2*}	P
	I	II	III	IV	V	I	II	III	IV	V				
Diabetes Mellitus														
Whorl	08	09	05	09	05	08	07	02	08	02	63	21	33.31**	$/ 0.001$
Loop	22	16	17	18	22	22	17	22	22	28	206	68.77		
Arch	00	05	08	03	03	00	06	06	00	00	31	10.33		
Controls														
Whorl	18	21	08	24	12	16	15	10	26	12	162	40.5	-	-
Loop	20	15	28	16	28	20	22	29	13	28	219	54.75		
Arch	02	04	04	00	00	04	03	01	01	00	19	4.75		

* Degrees of freedom (d.f.) is 2

** Highly significant value as compared to controls ($P / 0.001$)



SHOWING PERCENTAGE FREQUENCY OF DIGIT PATTERNS IN LATE ONSET DIABETES MELLITUS

In late onset female diabetics (table XII) it was observed that there was increased frequency of whorls in left digit II 50% and decreased incidence of loops 40% as compared to controls 15% and 85% respectively. At the same time in digit IV whorls were low 40% both in right and left as compared to controls 70% and 65% respectively while loops were 60% in both right and left as compared to 25% and 35% respectively. The frequency of arches was more in digit I right 25% and left 30% and in digit II right 25% and in left 10%. In addition to this left digits IV and V also showed increased frequency of arches 15% each.

From table XIII it is clear that digit patterns in late onset female diabetics are significantly different from controls ($P < 0.05$). The incidence of loops was low 56% as compared to 67.5% of controls while high incidence of arches 13.5% as compared to 2.5% of controls. No difference in whorls was found.

TABLE XII

Percentage frequency of digit patterns in late onset female diabetics(20 cases)and controls(20 cases).

DIGITS	RIGHT						LEFT					
	Whorl		Loop		Arch		Whorl		Loop		Arch	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
DIGIT I												
Diabetics	07	35	08	40	05	25	04	20	10	50	06	30
Controls	06	30	14	70	00	00	01	05	17	85	02	10
DIGIT II												
Diabetics	05	25	10	50	05	25	10	50	08	40	02	10
Controls	08	40	12	60	00	00	03	15	17	85	00	00
DIGIT III												
Diabetics	03	15	17	85	00	00	07	35	10	50	03	15
Controls	02	10	17	85	01	05	04	20	16	80	00	00
DIGIT IV												
Diabetics	08	40	12	60	00	00	08	40	12	60	00	00
Controls	14	70	05	25	01	05	13	65	07	35	00	00
DIGIT V												
Diabetics	05	25	12	60	03	15	04	20	13	65	03	15
Controls	05	25	15	75	00	00	05	25	14	70	01	05

TABLE XIII

Statistical analysis of digit patterns in late onset female diabetics (20 cases) and controls(20 cas

Pattern	RIGHT I	II	III	IV	V	LEFT I	II	III	IV	V	Total	%	X^{2*}	P
Diabetes Mellitus														
Whorl	07	05	03	08	05	04	10	07	08	04	61	30.5		
Loop	08	10	17	12	12	10	08	10	12	13	112	56	8.98**	$\not<$ 0.0
Arch	05	05	00	00	03	06	02	03	00	03	27	13.5		
Controls														
Whorl	06	08	02	14	05	01	03	04	13	05	61	30.5		
Loop	14	12	17	05	15	17	17	16	07	14	134	67.5	-	-
Arch	00	00	01	01	00	02	00	00	00	01	05	2.5		

* Degrees of freedom (d.f.) is 2

** [illegible] significant value as compared to controls ($P \not< 0.05$)

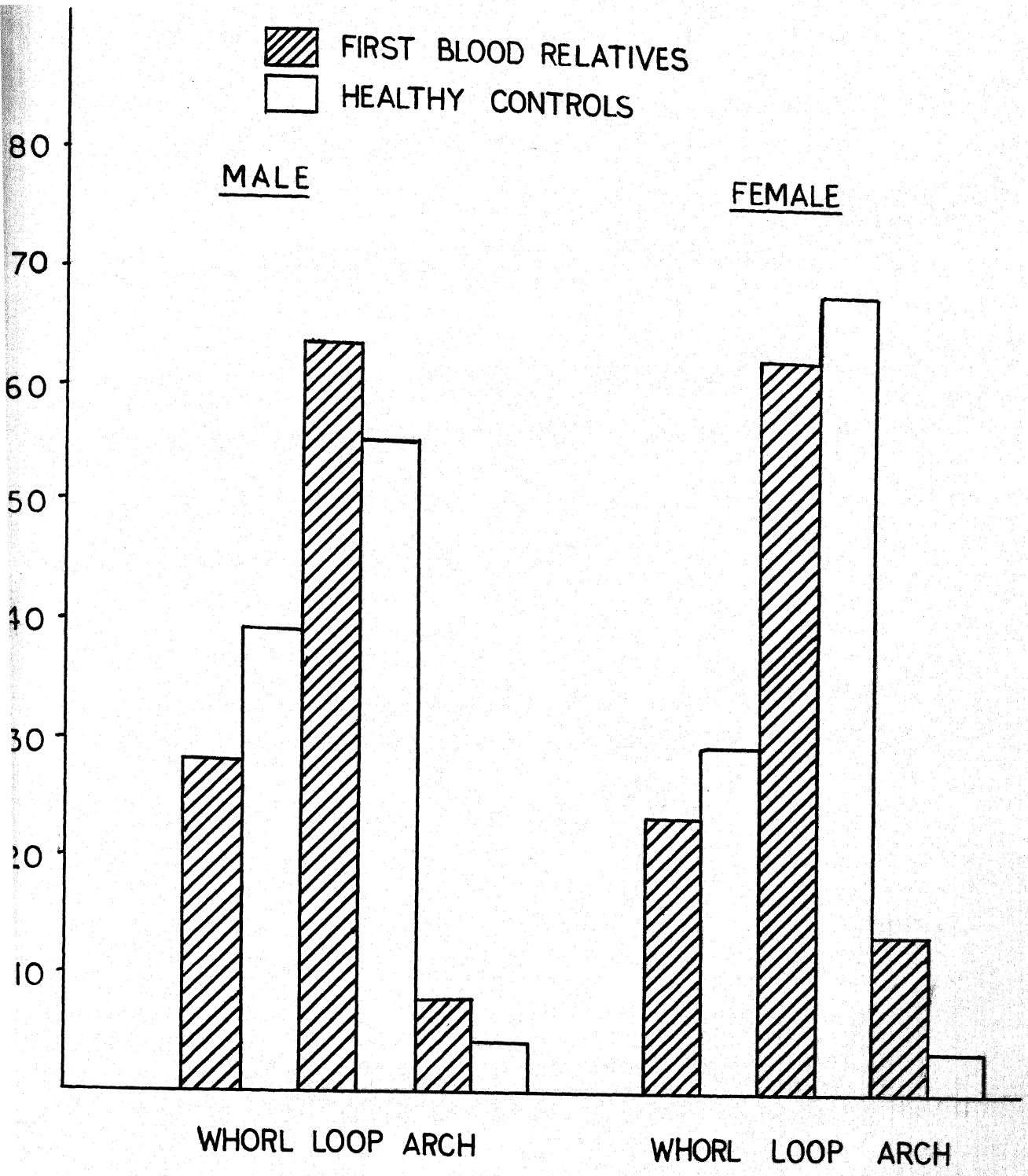
In male first blood relatives (table XIV) the incidence of whorls was low in digit V of right 12.5% and of left 10% as compared to 28.75% and 27.5% of controls. In left digit IV loops were more in frequency 62.5% as compared to 32.5% of controls while whorls less in frequency 37.5% as compared to 65% of controls.

Table XV shows statistical analysis of digit patterns and it was observed to be significant ($P < 0.01$) in male first blood relatives from controls. The incidence of whorls was low 28.75% as compared to 39% of controls while loops and arches were high 63.75% and 7.5% as compared to 55.5% and 5.5% of controls respectively.

TABLE XIV

Percentage frequency of digit patterns in first blood relatives (FBRs) males (40 cases) and controls (80 cases).

DIGITS	RIGHT						LEFT					
	Whorl		Loop		Arch		Whorl		Loop		Arch	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
DIGIT I												
FBRs	12	30	26	65	2	5	9	22.5	29	72.5	2	5
Controls	35	43.7	41	51.25	4	5	30	37.5	44	55	6	7.5
DIGIT II												
FBRs	18	45	17	42.5	5	12.5	13	32.5	21	52.5	6	15
Controls	41	51.25	31	38.75	8	10	29	36.25	42	52.5	9	11.25
DIGIT III												
FBRs	11	27.5	26	65	3	7.5	6	15	30	75	4	10
Controls	15	18.75	58	72.5	7	8.75	18	22.5	57	71.25	5	6.25
DIGIT IV												
FBRs	22	55	16	40	2	5	15	37.5	25	62.5	0	00
Controls	47	58.7	33	41.25	0	00	52	65	26	32.5	2	2.5
DIGIT V												
FBRs	5	12.5	33	82.5	2	5	4	10	32	80	4	10
Controls	23	28.75	57	71.25	0	00	22	27.5	55	68.75	3	3.75



SHOWING PERCENTAGE FREQUENCY OF DIGIT PATTERNS IN FIRST BLOOD RELATIVES OF DIABETES MELLITUS.

Table XVI indicates the 100% presence of loops in right digit III in female first blood relatives without any arch and whorl. The percentage frequency of arches were in digit I of both hands 25% each and in digit II and IV of right hand 30% and 15% respectively.

Statistical analysis (table XVII) shows that there was significant different digit patterns in female first blood relatives as compared to controls ($P < 0.001$). The incidence was low of whorls 24% and loops 63.5% as compared to 29.75% and 67.25% of controls respectively. while arches were high 12.5% as compared to 3% of controls.

TABLE XVI

Percentage frequency of digit patterns in first blood relatives(FBRs) females (20 cases) and of controls (40 cases).

DIGITS	RIGHT						LEFT					
	Whorl		Loop		Arch		Whorl		Loop		Arch	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
DIGIT I												
FBRs	7	35	8	40	5	25	2	10	13	65	05	25
Controls	12	30	28	70	0	00	3	7.5	33	82.5	4	10
DIGIT II												
FBRs	6	30	8	40	6	30	5	25	13	65	2	10
Controls	15	37.5	24	60	1	2.5	6	15	34	85	0	00
DIGIT III												
FBRs	0	00	20	100	0	00	3	15	17	85	00	00
Controls	4	10	35	87.5	1	2.5	7	17.5	32	80	1	2.5
DIGIT IV												
FBRs	10	50	7	35	3	15	10	50	10	50	0	00
Controls	27	67.5	11	27.5	2	5	25	62.5	15	37.5	0	00
DIGIT V												
FBRs	3	15	15	75	2	10	2	10	16	80	2	10
Controls	10	25	29	72.5	1	25	10	25	20	70	2	5

TABLE XVII

Statistical analysis of digit patterns in first blood relatives (FBRs) females (20 cases) and contro
(40 cases).

Pattern	RIGHT					LEFT					Total	%	X^{2*}	P
	I	II	III	IV	V	I	II	III	IV	V				
FBRs														
Whorl	07	06	00	10	03	02	05	03	10	02	48	24		
Loop	08	08	20	07	15	13	13	17	10	16	127	63.5	20.73**	$/\_$ 0.0
Arch	05	06	00	03	02	05	02	00	00	02	25	12.5		
Controls														
Whorl	12	15	04	27	10	03	06	07	25	10	119	29.75		
Loop	28	24	35	11	29	33	34	32	15	28	269	67.25	-	-
Arch	00	01	01	02	01	04	00	01	00	02	12	3		

* Degrees of freedom (d.f.) is 2

** Highly significant value as compared to controls (P $/\_$ 0.001)

Axial Triradii :

Table XVIII shows the frequency of axial triradii in cases of early onset diabetes mellitus (males and females) and healthy controls (males and females). Axial triradius (t) was the commonest in the palms of both the groups. The frequency of t was however more than controls but the value was statistically insignificant ($P > 0.05$) in both males and females of early onset diabetics.

In late onset diabetes mellitus (table XIX) the frequency of t was commonest in both palms in males 76.67% in right and 80% in left as compared to 75% and 62.5% in controls. The t was commonest in right palm 50% and in left palm 50% as compared to controls 55% and 55% respectively. The difference was not statistically significant ($P > 0.05$).

In first blood relatives (table XX) the frequency of t was commonest in both males and females in both palms. In the males t was 72.5% in left palm, 67.5% in right palm and in the females t was 65% and 50% in right and left palm respectively. The difference from controls was not of statistical significance ($P > 0.05$).

TABLE XVIII

Percentage frequency of axial triradii in 50 cases (30 males and 20 females) of early onset diabetes mellitus and 60 controls (40 males and 20 females).

	RIGHT PALM									LEFT PALM								
	t		t'		t"		to		X^2	t		t'		t"		to		X^2
	No.	%	No.	%	No.	%	No.	%		No.	%	No.	%	No.	%	No.	%	
Diabetes Mellitus (Males)	25	83.33	03	10	0	0	2	6.67	0.11*	22	73.33	05	16.67	0	0	03	10	0.91*
Controls (Males)	32	80	03	7.5	0	0	5	12.5		25	62.5	09	22.5	0	0	06	15	
Diabetes Mellitus (Females)	15	75	05	25	0	0	0	00	1.04*	12	60	03	15	0	0	05	25	1.6 *
Controls (Females)	12	60	06	30	0	0	2	10		08	40	10	50	0	0	02	10	

* Not significant (P 70.05)

Axial Triradii :

Table XVIII shows the frequency of axial triradii in cases of early onset diabetes mellitus (males and females) and healthy controls (males and females). Axial triradius (t) was the commonest in the palms of both the groups. The frequency of t was however more than controls but the value was statistically insignificant ($P > 0.05$) in both males and females of early onset diabetics.

In late onset diabetes mellitus (table XIX) the frequency of t was commonest in both palms in males 76.67% in right and 80% in left as compared to 75% and 62.5% in controls. The t was commonest in right palm 50% and in left palm 50% as compared to controls 55% and 55% respectively. The difference was not statistically significant ($P > 0.05$).

In first blood relatives (table XX) the frequency of t was commonest in both males and females in both palms. In the males t was 72.5% in left palm, 67.5% in right palm and in the females t was 65% and 50% in right and left palm respectively. The difference from controls was not of statistical significance ($P > 0.05$).

TABLE XVIII

Percentage frequency of axial triradii in 50 cases (30 males and 20 females) of early onset diabetes mellitus and 60 controls (40 males and 20 females).

	RIGHT PALM									LEFT PALM								
	t		t'		t"		to		X^2	t		t'		t"		to		X^2
	No.	%	No.	%	No.	%	No.	%		No.	%	No.	%	No.	%	No.	%	
Diabetes Mellitus (Males)	25	83.33	03	10	0	0	2	6.67	0.11*	22	73.33	05	16.67	0	0	03	10	0.91*
Controls (Males)	32	80	03	7.5	0	0	5	12.5		25	62.5	09	22.5	0	0	06	15	
Diabetes Mellitus (Females)	15	75	05	25	0	0	0	00	1.04*	12	60	03	15	0	0	05	25	1.6 *
Controls (Females)	12	60	06	30	0	0	2	10		08	40	10	50	0	0	02	10	

* Not significant (P 70.05)

TABLE XIX

Percentage frequency of axial triradii in 50 cases (30 males and 20 females) of late onset diabetes mellitus and 60 controls (40 males and 20 females).

	RIGHT PALM									LEFT PALM								
	t		t'		t"		to		X^2	t		t'		t"		to		X^2
	No.	%	No.	%	No.	%	No.	%		No.	%	No.	%	No.	%	No.	%	
Diabetes Mellitus (Males)	23	76.67	3	10	0	0	4	13.33	0.025*	24	80	3	10	0	0	3	10	2.50 *
Controls (Males)	30	75	5	12.5	0	0	5	12.5		25	62.5	8	20	0	0	7	17.5	
Diabetes Mellitus (Females)	10	50	6	30	0	0	4	20	0.1*	10	50	7	35	0	0	3	15	0.1*
Controls (Females)	11	55	7	35	0	0	2	10		11	55	8	40	0	0	1	05	

* Not significant ($P > 0.05$)

TABLE XX

Percentage frequency of axial triradii in 60 cases (40 males and 20 females) of first blood relative (FBRs) and 120 controls (80 males and 40 females).

	RIGHT PALM									LEFT PALM								
	t		t'		t"		to		x^2	t		t'		t"		to		x^2
	No.	%	No.	%	No.	%	No.	%		No.	%	No.	%	No.	%	No.	%	
FBRs (Males)	27	67.5	5	12.5	0	0	8	20	1.50*	29	72.5	4	10	0	0	7	17.5	1.16*
Controls (Males)	62	77.5	8	10	0	0	10	12.5		50	62.5	17	21.25	0	0	13	16.25	
FBRs (Females)	13	65	4	20	0	0	3	15	0.31*	10	50	7	35	0	0	3	15	0.86 *
Controls (Females)	23	57.5	13	32.5	0	0	4	10		15	37.5	21	52.5	0	0	4	10	

* Not significant ($P > 0.05$)

Total Finger Ridge Count (TFRC) :

Table XXI shows the statistical analysis of mean total finger ridge count (TFRC) of early onset diabetics as compared to controls. Though the count was less in both males and females from control i.e. 117.88 in male diabetics and 113.75 in female diabetics as compared to controls 133.93 and 125.5 respectively. However the difference was not of statistical significance ($P > 0.05$).

TABLE XXI

Statistical analysis of total finger ridge count (TFRC) of early onset diabetes mellitus and controls.

	MALES		FEMALES	
	Diabetes mellitus (n = 30)	Controls (n = 40)	Diabetes mellitus (n = 20)	Controls (n = 20)
Mean ± S.D.	117.88 ± 39.36	133.93 ± 36.88	113.75 ± 48.84	125.50 ± 31.73
P value	> 0.05 N.S.		> 0.05 N.S.	

N.S. Not significant

From table XXII it is evident that there was no statistical significant difference in late onset diabetics ($P > 0.05$). In both males and females again the value was lower than controls. Mean total finger ridge count was 124 in males and 118.25 in females while in controls 135.93 and 123.25 respectively.

TABLE XXII

Statistical analysis of total finger ridge count (TFRC) of late onset diabetes mellitus and controls.

	MALES		FEMALES	
	Diabetes Mellitus (n = 30)	Controls (n = 40)	Diabetes mellitus (n = 20)	Controls (n = 20)
Mean ± S.D.	124.00 ± 42.12	135.93 ± 40.66	118.25 ± 38.88	123.25 ± 32.78
'P' value		> 0.05 N.S.		> 0.05 N.S.

N.S. Not significant

In first blood relatives (table XXIII) again the mean total finger ridge count (TFRC) was low as compared to controls. However the value was not of statistical significance in both males and females ($P > 0.05$).

TABLE XXIII

Statistical analysis of total finger ridge count (TFRC) of first blood relatives and controls.

	MALES		FEMALES	
	First blood relatives (n = 40)	Controls (n = 80)	First blood relatives (n = 20)	Controls (n = 40)
Mean ± S.D.	125.97 ± 29.83	134.93 ± 38.65	113.00 ± 28.74	124.38 ± 32.27
'P' value		> 0.05 N.S.		> 0.05 N.S.

N.S. Not significant

a t d angles :

Table XXIV shows statistical analysis of mean value of a t d angle in early onset diabetes mellitus as compared to controls. The mean value of atd angle was 1°-2° degree more in diabetics of both sexes but the difference was not of statistical significance ($P > 0.05$).

TABLE XXIV

Statistical analysis of mean values of atd angle (in degrees) in early onset diabetes mellitus (30 males, 20 females) and controls (40 males and 20 females).

	RIGHT PALM Mean ± S.D.	LEFT PALM Mean ± S.D.
Males		
Diabetes Mellitus	42.04 ± 9.73	41.08 ± 11.68
Controls	40.70 ± 13.87	40.53 ± 15.62
'P' value	> 0.05	> 0.05
	N.S.	N.S.
Females		
Diabetes Mellitus	43.50 ± 13.72	41.25 ± 14.53
Controls	40.00 ± 12.77	39.58 ± 12.89
'P' value	> 0.05	> 0.05
	N.S.	N.S.

N.S. Not significant

In late onset diabetes mellitus (table XXV) the difference of mean value of atd angle was not of statistical significance in both males and females as compared to controls ($P > 0.05$). The value was 1°-2° more in males of both palms while 1-2° less in females of both palms as compared to controls.

TABLE XXV

Statistical analysis of mean values of atd angle (in degrees) in late onset diabetes mellitus (30 males and 20 females) and controls (40 males and 20 females).

	RIGHT PALM Mean ± S.D.	LEFT PALM Mean ± S.D.
Males		
Diabetes Mellitus	39.50 ± 15.62	38.78 ± 13.23
Controls	37.70 ± 13.66	36.50 ± 15.32
'P' value	> 0.05 N.S.	> 0.05 N.S.
Females		
Diabetes Mellitus	40.02 ± 13.22	40.38 ± 16.42
Controls	41.50 ± 12.55	42.25 ± 15.35
'P' values	> 0.05 N.S.	> 0.05 N.S.

N.S. Not significant

The mean value of atd angle in first blood relatives (table XXVI) again the difference was not of statistical significance (P $\bar{7}$0.05). However the value was 1°-2° less in both palms of males and in left palm of females while less in right palm by 5°.

TABLE XXVI

Statistical analysis of mean values of atd angle (in degrees) in first blood relatives (40 males and 20 females) and controls (80 males and 40 females).

	RIGHT PALM Mean ± S.D.	LEFT PALM Mean ± S.D.
Males		
First blood relatives.	37.82 ± 16.65	36.68 ± 14.65
Controls	39.20 ± 15.45	38.52 ± 15.28
'P' value	$\bar{7}$0.05 N.S.	$\bar{7}$0.05 N.S.
Females		
First blood relatives	35.50 ± 14.9	39.90 ± 15.63
Controls	40.75 ± 12.32	40.92 ± 14.62
'P' value	$\bar{7}$0.05 N.S.	$\bar{7}$0.05 N.S.

N.S. Not significant.

DISCUSSION

There are physiological variations among dermatoglyphics which are attributed to different races, ethnic groups, sex and extremity. The patterns are strongly but not exclusively influenced by heredity. Moreover, dermatoglyphic patterns are polygenic in inheritance and they are also sex linked. Studies on inheritance of dermatoglyphic patterns by qualitative and quantitative methods have shown greater resemblance among monozygotic twins and a reasonaly strong inheritance among sibs and parents (Galton, 1892, Bonnevie, 1924, Holt, 1961, 1968). The total finger ridge count is an inherited metrical character in which a number of perfectly additive genes are concerned and in which environment plays a comparatively small part (Holt,1968).

The pattern of inheritance in diabetes is believed by some investigators to be autosomal recessive (Pincus and White, 1933, Barrai and Cann, 1965) but others believe it to be an example of polygenic inheritance, being determined by several genes each with a additive effect modified to a greater or lesser extent by environmental influences. Recessive inheritance is made unlikely by the consistent finding that the incidence of diabetes in parents and children (when corrections have been made for age) is as high as in sibs (Carter, 1969). The concept that idiopathic diabetes mellitus is genetically heterogenous group of

disorders has been established by twin and HLA studies that have permitted the separation of juvenile-onset and maturity-onset diabetes (Rotter, 1978).

Prompted by the impact of the above studies an attempt was made to relate the genetic heterogeneity of diabetes mellitus with the dermatoglyphic pattern.

In the present study, palmar dermatoglyphics were analysed in a total of 280 subjects which included 100 cases of diabetes mellitus (early and late onset), 60 of their first blood relatives and 120 age and sex matched normal healthy subjects.

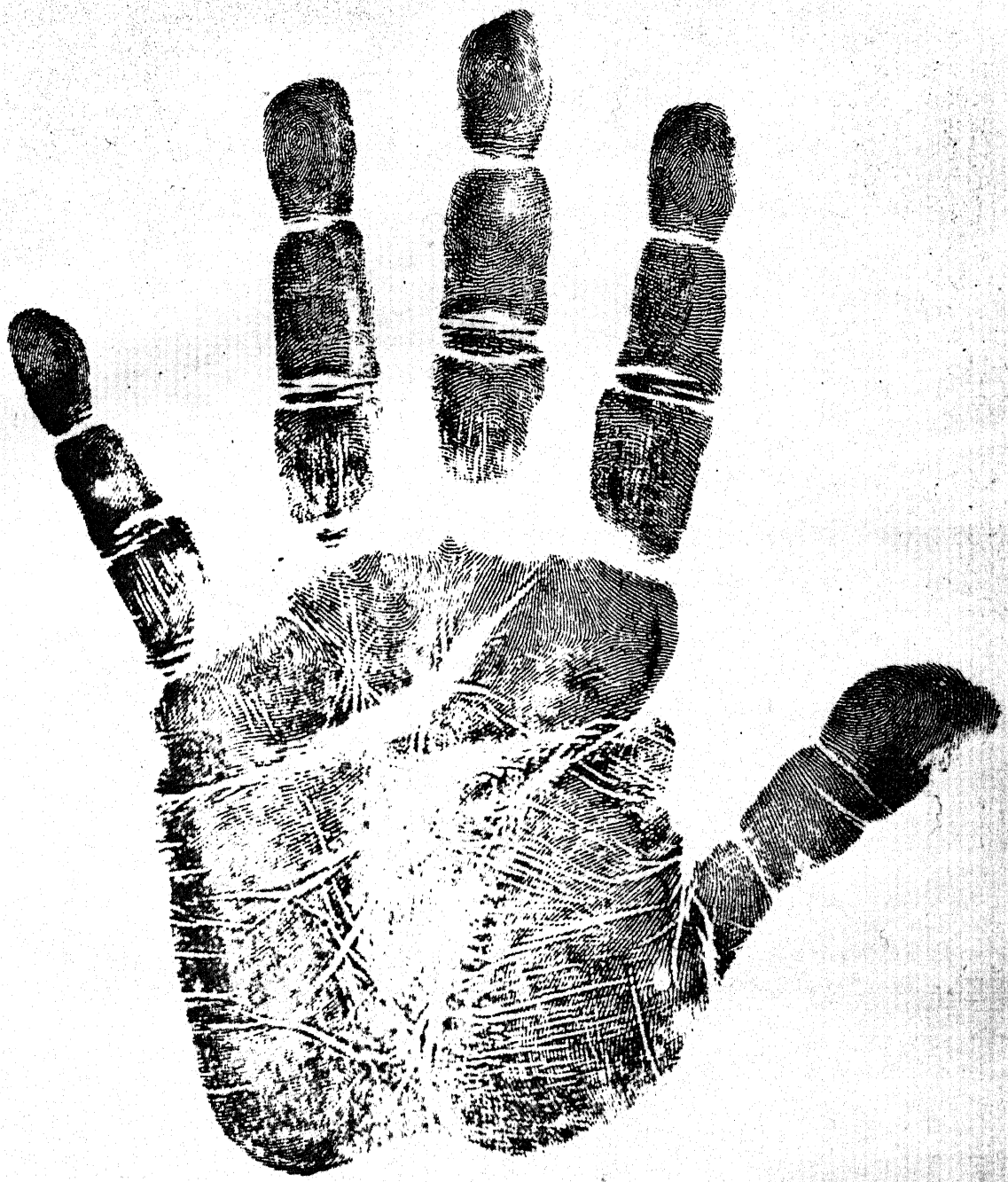
The diabetics were all receiving treatment and all had developed diabetes spontaneously before 40 years of age (early onset) or afterwards (late onset). There were 50 cases of early-onset diabetes mellitus (30 males and 20 females) and 50 cases of late onset diabetes mellitus (30 males and 20 females). Among first blood relatives 40 were males and 20 females. The number of females was less may be because married females leave their parental homes to live with their husband and were therefore not available at Jhansi for study. Secondly they being busy in household cores and being more superstitious were unwilling to come to the hospital for this study.

Where in this study the increase frequency of whorls was found in only early onset male diabetics,

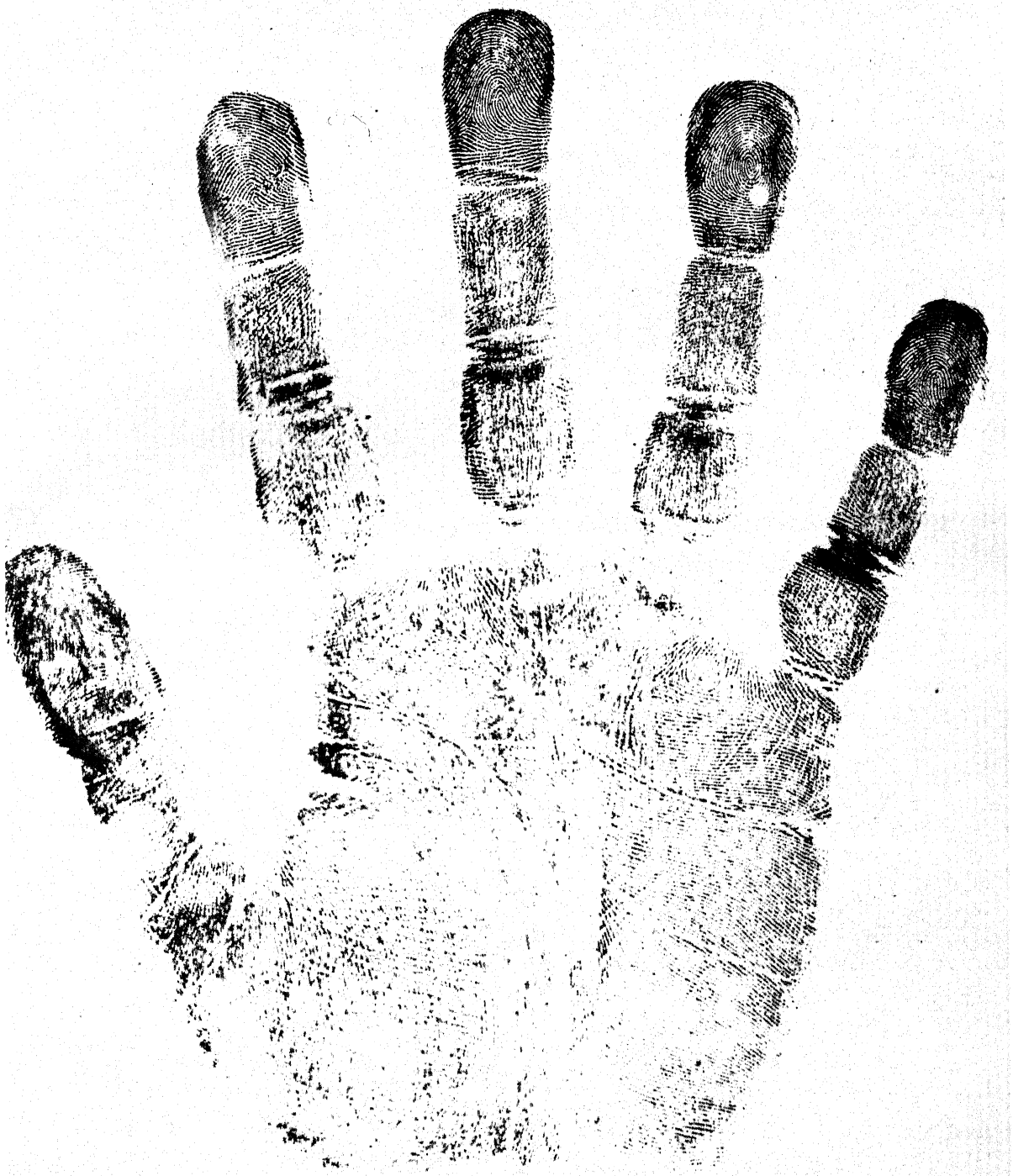
Vormittag et al (1974) observed similar findings in early and late onset male diabetics. In Indian population Bhu et al (1980) studied and observed same finding 52.5% while in this study it was 49%. In contrast, where there was no increase of whorls in female diabetics of either group in this study, Verbov (1973) found a decreased frequency of whorls in early onset female diabetics and there was no difference in early onset male diabetics from controls. However no observations were made in late onset diabetes mellitus. At the same time in this study the frequency of whorls was low in late onset male diabetics 21% and female diabetics 24% as compared to controls.

In agreement with the findings of Bhu et al (1980) a decreased frequency (40%) of loops in early onset male diabetics was observed in this study. Vormittag et al (1974) also observed same finding. However in this series a highly significant increase in late onset male diabetics 68.77% was observed which is also in confirmity with the findings of Bhu et al (1980). This study also showed decreased frequency of loops in early and late onset female diabetics.

Bhu et al (1980) observed increased incidence of arches in early and late onset of both male and female diabetics which is similar to the present study. Vormittag et al (1974) observed same findings in early



PALM PRINT OF EARLY ONSET MALE DIABETIC



PALM PRINT OF LATE ONSET MALE DIABETIC

TABLE XXVII

Digit Patterns in diabetes mellitus in various studies.

		Patterns	Verbov (1973)	Vormittag et al (1974)	Bhu et al (1980)	Present study
Early onset	Males	Whorl	(-)	High	High	High
		Loop	(-)	Low	Low	Low
		Arch	(-)	High	High	High
	Females	Whorl	Low	(-)	(-)	(-)
		Loop	(-)	(-)	(-)	Low
		Arch	High	(-)	High	High
Late onset	Males	Whorl	-	High	(-)	Low
		Loop	-	(-)	High	High
		Arch	-	High	High	High
	Females	Whorl	-	(-)	(-)	(-)
		Loop	-	(-)	(-)	Low
		Arch	-	(-)	High	High

High Significantly high frequency
Low Significantly low frequency
(-) Not significant difference
\- Not studied.

and late onset male diabetics only. The above findings are in contrast of observations made by Verbov (1973) in which no difference in arches was found in early onset male diabetics. However observations on early onset female diabetics are in agreement with this study. In table XXVII digital patterns in diabetes mellitus have been shown in comparison with other studies.

The frequency of axial triradius t was commonest among diabetics as in healthy controls. No t" was observed in diabetics as well as in controls. The study of axial triradii was not reported in other studies.

In the present study the mean total finger ridge count was not statistically different from controls and the same findings have been reported by Verbov (1973), Vormittag et al (1974) and Bhu et al (1980).

This study also did not show any deviation of mean value of atd angle from normals and the same has been reported by Verbov (1973) and Bhu et al (1980) while Vormittag et al (1974) have not commented on this.

In table XXVIII axial triradii, mean total finger ridge count (TFRC) and mean atd angle have been compared with other reports.

TABLE XXVIII

Axial triradii, atd angle and total finger ridge count in various studies.

	Axial Triradii	atd Angle	Total Finger Ridge Count
Verbov (1973)	-	N.S.	N.S.
Vormittag et al (1974)	-	N.S.	N.S.
Bhu et al (1980)	-	N.S.	N.S.
Present study	N.S.	N.S.	N.S.

N.S. Not significant
\- Not studied

First Blood Relatives :

In the present study, 60 available first blood relatives were studied out of which 40 were males and 20 females.

Since similar studies have not been reported in the first blood relatives of diabetes mellitus cases, in available literature, it is not possible to compare the results at present.

The presence of whorls in males first blood relative was low (28.75%) which was similar to late onset male diabetes (21%). The incidence of loops in males first blood relative was high (63.75%) which is again similar to late onset male diabetics (68.77%). Arches were also more (7.5%) as in late onset male diabetics (10.33%). This finding suggests strong genetic factor in late onset diabetes mellitus. As monozygotic twins develop diabetes in 100% cases after 40 years and in only 50% when they develop diabetes before this which may be a possible explanation (Tattersall, 1972).

In first blood relative females the digit patterns were not similar to late onset female diabetics. There were decreased frequency of loops 63.5% and increased frequency of arches 12.5% as in females of late onset diabetes 56% and 13.5% respectively. However whorls were of decreased frequency in female first blood relatives but not in female late onset diabetics.

In table XXIX digit patterns in first blood relatives in present study were tabulated.

TABLE XXIX

Digit patterns in first blood relatives in present study.

Pattern	Males	Females
Whorl	Low	Low
Loop	High	Low
Arch	High	High

High Significantly high frequency

Low Significantly low frequency

Why male first blood relatives were having similar pattern as late onset male diabetics in comparison to female first blood relatives which have two of the three patterns. It is difficult to answer but it may be due to the fact that in identical twins, male twins tended to be concordant more often than female twins (Pyke, 1976).

It has been clearly established in recent years that diabetes mellitus is a genetically heterogenous group of disorders that share glucose intolerance in common (Creutzfeldt, 1976). Heterogeneity implies that different genetic and/or environmental etiologic factors can result in similar

phenotypes. The extent of the heterogeneity within the early onset (/ 40 years) and late onset (7 40 years) forms of diabetes mellitus, however, is still in question. It seems likely that early onset diabetes represents a number of different genetic disorders in which environment frequently plays some part; if this is so, larger dermatoglyphic differences between diabetics and controls may be concealed until we are able to subclassify early-onset diabetes mellitus.

It has long been recognized that certain families have a predisposition or increased susceptibility to develop diabetes mellitus as genetic influence is one of the important risk factors in the genesis of this disease. However the only problem remaining is to elucidate the mode of inheritance. Palmar dermatoglyphics may be helpful in studying the heterogeneity of diabetes mellitus and to identify susceptible individuals to non-susceptible one.

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SUMMARY & CONCLUSIONS

The term "Dermatoglyphics" was coined by Cummins and Midlo in 1926 to describe the fine grooves and ridges in the epidermis which are known to depict genetic constitution.

Genetic predisposition is one of the important etiological factors in the genesis of diabetes mellitus. Consequently, it was thought that a study of palmar dermatoglyphics may yield some marker in diabetes mellitus cases and their first blood relatives. It was with this aim and object that the present work was taken up.

Palmar dermatoglyphics were analysed in a total of 280 subjects which included 100 consecutive cases of diabetes mellitus (50 early onset and 50 late onset) 60 their first blood relatives and 120 age and sex matched normal healthy subjects.

Cotterman technique of taking palmar prints was used. These prints were analysed with the help of a magnifying lens. The four standard parameters of dermatoglyphics studied in the present study, were the following :

1. Digit patterns.
2. Ridge count from triradial point to point of core.
3. Axial triradii
4. atd angle.

The significant findings were in digit patterns of diabetes mellitus and their first blood relatives. In early onset male diabetics there was high incidence of whorls and low incidence of loops. In late onset male diabetics there was high incidence of loops and low incidence of whorls. In both early and late onset female diabetics there was low incidence of loops. In first blood relative males there was high incidence of loops and low incidence of whorls. In first blood relative females there was low incidence of whorls and loops. The incidence of arches were high in both males and females in diabetes mellitus as well as in first blood relatives. These differences were statistically significant ($P < 0.05$).

The other dermatoglyphic parameters viz. mean total finger ridge count (TFRC), axial triradii and mean atd angle were largely similar to controls and the difference if any were not statistically significant.

Among first blood relatives studied dermatoglyphic patterns in males were similar to those of late onset male diabetics. There was less similarity in first blood relative females to late onset female diabetics. These findings indicate that there is strong genetic factor in late onset diabetes mellitus as compared to early onset and in identical twins, male twins tended to be concordant more often than female twins (Tattersall, 1972; Pyke, 1976).

The dermatoglyphic variations in diabetes mellitus cases and first blood relatives from controls may be suggestive of an external imprint of genentic variation. Present methods of study of dermatoglyphics is not of much help in diagnosis of diabetes mellitus, however certain significant differences have been noticed in the diabetes mellitus cases and their first blood relatives. The natural history of diabetes mellitus has prediabetic, latent chemical diabetic phase before it manifests clinico-biochemically. It has been clearly established in recent years that diabetes mellitus is genetically heterogenous group of disorders that share glucose intolerance in common. Palmar dermatoglyphics may be helpful in studying the heterogeneity of diabetes mellitus and to identify susceptible individuals to non-susceptible one.

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C O N C L U S I O N S

This study has revealed certain significant findings in diabetes mellitus and their first blood relatives. However it will be too preliminary to draw definite conclusions on these findings at this stage in diagnosis of diabetes mellitus. The findings are as follows :

1. Higher incidence of whorls and lower incidence of loops in early onset male diabetics.
2. Higher incidence of loops and lower incidence of whorls in late onset male diabetics.
3. Lower incidence of loops in early and late onset female diabetics.
4. Higher incidence of loops and lower incidence of whorls in first blood relative males.
5. Lower incidence of whorls and loops in first blood relative females.
6. Higher incidence of arches in both males and females in diabetes mellitus as well as in first blood relatives.

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APPENDICES

APPENDIX I

CLINICAL AND BIOCHEMICAL CRITERIA FOR THE DIAGNOSIS OF DIABETES MELLITUS :

(World Health Organization Technical Report Series, 646 :10, 1980)

The Expert Committee recommended the following procedure for diagnosis.

(1) If symptoms of diabetes are present, perform random or fasting blood glucose measurement. In adults, random venous plasma values of 11 mmol/l (2.0 g/l) or more or fasting values of 8 mmol/l (1.4 g/l) or more are diagnostic. Random values below 8 mmol/l and fasting values below 6 mmol/l (100 g/l) exclude the diagnosis.

(2) If results are equivocal, measure blood glucose concentration 2 hours after 75 g of glucose taken orally after an overnight fast (Annex 2). Two hour venous plasma glucose values of 11 mmol/l (2.0 g/l) or more are diagnostic of diabetes. Values below 8 mmol/l (1.4 g/l) are normal and those in the range 8-11 mmol/l (1.4-2.0 g/l) are termed "impaired glucose tolerance".

(3) In the absence of symptoms of diabetes at least one additional abnormal blood glucose value is needed to confirm the clinical diagnosis (e.g. a 1 hour post glucose value of 11 mmol/l (2.0 g/l) or more during the first test or an elevated 2 hour or fasting glucose value on a subsequent occasion).

TABLE : Diagnostic values for oral glucose tolerance test under standard conditions. Load 75 g glucose in 250-350 ml of water for adults or 1.75 g/kg body weight (to a maximum of 75 g) for children, using specific enzymatic glucose assay. Two classes of response are identified - diabetes mellitus and impaired glucose tolerance.

	Glucose concentration		
	Venous whole blood	Capillary whole blood	Venous plasma
DIABETES MELLITUS			
Fasting	⩾ 7.0 mmol/l (⩾ 1.2 g/l)	⩾ 7.0 mmol/l (⩾ 1.2 g/l)	⩾ 8.0 mmol/l (⩾ 1.4 g/l)
and/or 2 hours after glucose load	⩾ 10.0 mmol/l (⩾ 1.8 g/l)	⩾ 11.0 mmol/l (⩾ 2.0 g/l)	⩾ 11.0 mmol/l (⩾ 2.0 g/l)
IMPAIRED GLUCOSE TOLERANCE			
Fasting	< 7.0 mmol/l (< 1.2 g/l)	< 7.0 mmol/l (< 1.2 g/l)	< 8.0 mmol/l (< 1.4 g/l)
and 2 hours after glucose load	⩾ 7.0-< 10.0 mmol/l (⩾ 1.2-< 1.8 g/l)	⩾ 8.0-< 11.0 mmol/l (⩾ 1.4-< 2.0 g/l)	⩾ 8.0-< 11.0 mmol/l (⩾ 1.4-< 2.0 g/l)

APPENDIX II

PROFORMA

Cose No.....

Patient Name : Age & Sex :

Occupation: Physician I/C :

Address: Registration No.:

(1)(a) Insulin Dependent

(b) Insulin Non-dependent

(i) Obese

(ii) Non obese

(2) Complication: Yes/No

Family History of Diabetes Mellitus: Positive/Netative

Total first Blood Relatives (Alive): -

Total Blood Relative available :

Name with relation	Age & Sex	Address	Personal H/O Diabetes Mellitus	Blood sugar F	Blood sugar P.P.	Remarks

ANALYSIS OF PALMAR PRINTS

1. Digit pattern (P)

2. Ridge count from Triradial point of core (RC)

Name of patient and relation	RIGHT PALM										Remarks
	I		II		III		IV		V		
	P	RC	P	RC	P	RC	P	RC	P	RC	

Name of patient and relation	LEFT PALM										Remarks
	I		II		III		IV		V		
	P	RC	P	RC	P	RC	P	RC	P	RC	

3. Axial Triradii(t) and atd angle.

Name of patient and relation	RIGHT PALM		LEFT PALM		Remarks
	t	∠ atd	t	∠ atd	